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# A new species of *Reticulolaelaps* Costa (Mesostigmata: Laelapidae) from the Iberian Peninsula, with a key to world species

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## Original research

### ABSTRACT

A new species, *Reticulolaelaps caditanus* n. sp., is described based on adult females found in an oothecal cell of *Mantis religiosa*. The species has several morphological characteristics, including the presence of presternal shields, endopodal III-IV widely connected with sternal shield, 50 pairs of dorsal setae and at least 11 setae “x”, curly and barbed, and thin and smooth ventral setae including six pairs of setae on the genitoventral shield. A revised diagnosis of the genus with the addition of new characters and a key to the world species of the genus are provided.

**Keywords** Acari; Mesostigmata; Laelapidae; *Reticulolaelaps*; Iberian Peninsula

**Zoobank** <http://zoobank.org/2657C0E4-F4B8-4680-B699-9970DEDE9A6B>

## Introduction

The genus *Reticulolaelaps* Costa (species type *R. faini* Costa) was described by Costa (1968) on the basis of adult males and females from forest litter (*Quercus-Styrax*) in Israel.

In recent years the genus has gone through new definitions and diagnoses. Nemati *et al.* (2013) clarified the original diagnosis of this genus and transferred *Pseudoparasitus lativentris* Karg, 1978 to *Reticulolaelaps*. Joharchi & Babaeian (2015) refined this diagnosis giving new, albeit incomplete data as to idiosomal poroidotaxy and adenotaxy, and legs characters including leg chaetotaxy; at the same time, *P. lativentris* was excluded from *Reticulolaelaps* due to the absence of hypostomal flaps and other gnathosomatic attributes, leg chaetotaxy and male ventral shielding. Recently, Nemati *et al.*, (2019) transferred *Laelaspisella elsae* Joharchi, Babaeian & Jalalizand, 2016 and *P. lativentris* to *Reticulolaelaps* based on precise observations of these two taxa; *Pseudoparasitus jilinensis* Ma, 2004 was also provisionally transferred to *Reticulolaelaps* pending a careful study of the type materials. They described new diagnostic characters for *R. lativentris*, including remnants of membranous hypostomal flaps, gave new information on female characters of *R. faini*, and provided a new definition and diagnosis of *Reticulolaelaps* together with a new definition of *Pseudoparasitus*. Currently, five species complete the list of recognized species of *Reticulolaelaps* – *R. costai* Joharchi & Babaeian, 2015, *R. elsae* (Joharchi *et al.*, 2016), *R. faini* Costa, 1968, *R. hallidayi* Joharchi, Nemati & Babaeian, 2013, and *R. jilinensis* (Ma, 2004).

Members of the genus *Reticulolaelaps* were found in soil, litter, tree bark (Costa, 1968; Ma, 2004; Ghafarian *et al.*, 2012), as well as in ant nests (Formicidae) (Nemati *et al.*, 2013; Joharchi & Babaeian, 2015; Joharchi *et al.*, 2016).

In this paper, although it was not possible to account for intraspecific variation because of the limited number of specimens available and the single population sampled, the findings presented here may help to clarify the diagnostic attributes of the genus.

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## Material and methods

Mites were manually removed from the inside of an empty oothecal cell of *Mantis religiosa* (L.) using a fine brush under a binocular microscope, preserved in 70% alcohol and later cleared in Nesbitt's fluid and mounted in Hoyer's medium. Morphological observations, measurements, and illustrations were made using compound microscopes equipped with differential interference contrast and phase contrast optical systems, drawing tubes and stage-calibrated eyepiece micrometers. Setal notation for the idiosoma follows Lindquist & Evans (1965). Measurements of structures are given in micrometers ( $\mu\text{m}$ ). Dorsal shield length is midline from anterior margin of vertex to caudal margin. Length of ventral idiosomatic shields are midline, from the anterior margin to posterior edge of each shield. Notation for leg and palpal setation follows Evans (1963, 1964). Leg lengths are from the base of the coxa to the apex of the tarsus, excluding the pretarsus. Distinction of pore-like structures on the idiosomatic integument as either poroids (lyrifissures) or glandular openings (solenostomes), as distinguished morphologically by Athias-Henriot (1969) and physiologically by Krantz & Redmond (1987), is presented stylistically in the illustrations. Gland pores are shown in circular form, while poroids are shown in elliptical form following Johnston & Moraza (1991).

The holotype and paratype of the new species are deposited in the Museum of Zoology, University of Navarra, Pamplona, Spain.

## Taxonomy

### *Reticulolaelaps caditanus* new species

(Figures 1A-E, 2A-H, 3A-J)

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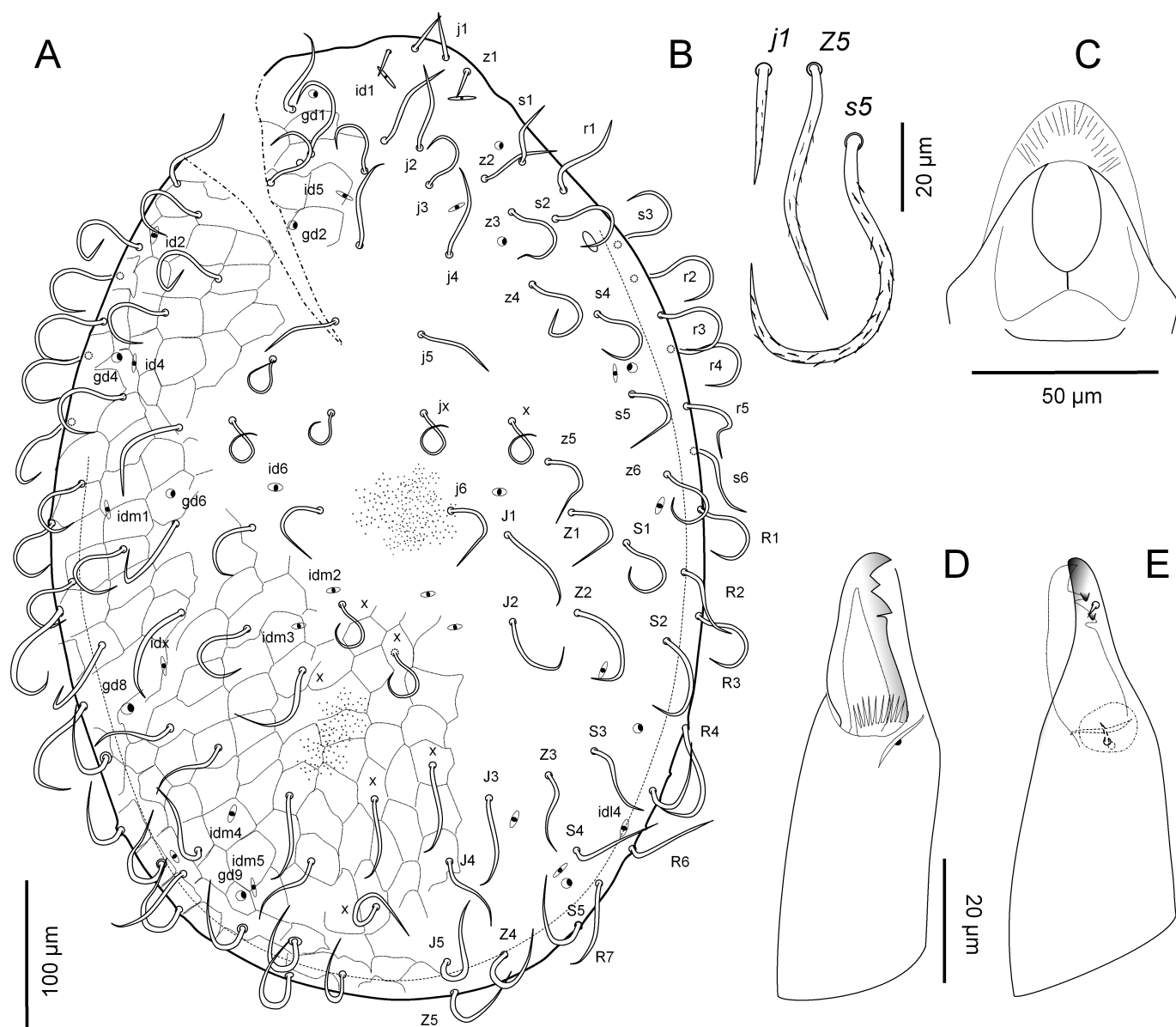
**Diagnosis** — Adult female: Dorsal setae curly and strongly barbed, longer than intervals between their bases; 24 pairs podonotal (*j1-j6*, *z1-z6*, *s1-s6*, *r1-r5*) plus five seta *jx*, and 21 pairs of opisthonotal setae (*J1-J5*, *Z1-Z5*, *S1-S5*, *R1-R7*), plus six setae *Jx*; presternal shields present; endopodal plates III-IV fused with sternal shield; genitoventral shield with six pairs of smooth setae, ventral setae as long as sternal setae; legs I and II with thick, spine-like ventral setae; gnathotectum as long as wide.

### Description of the female

Idiosoma 537 long, 439 wide at level of setae *J1* (female, holotype).

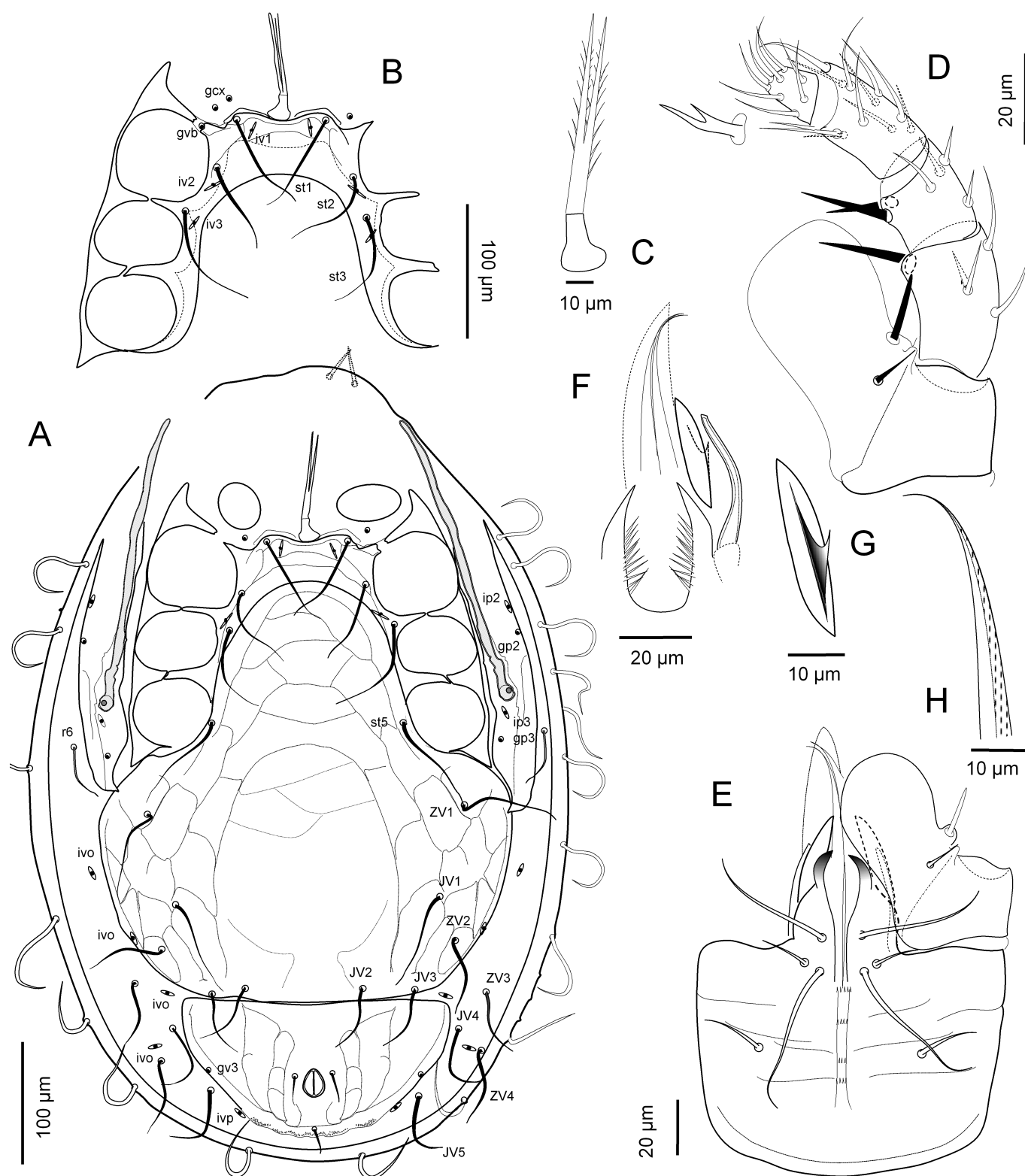
**Idiosomal dorsum** (Figure 1A) — Dorsal shield convex, densely punctate, with a conspicuous reticulate ornamentation over the antero-lateral and posterior half of the surface; opisthogastric surrounding soft integument striate. Dorsal shield with complete chaetome (*j1-j6*, *z1-z6*, *s1-s6*, *r1-r5*, *J1-J5*, *Z1-Z5*, *S1-S5*, *R1-R7*), and accessory setae “x” between podonotal and opisthonotal setae “j” and “J”; setae *r6* off the shield, on soft cuticle (Figure 2A); podonotal region with three pairs of discernible glandular pores (*gd1*, *gd2*, *gd4*) and five pairs of lyrifissures (*id1*, *id2*, *id4*, *id5*, *id6*); opisthonotal region with 14 pairs of pore-like structures (three pairs of glandular pores – *gd6*, *gd8*, *gd9* – and 11 pairs of lyrifissures) as on other laelapid mites. Dorsal setae longer than intervals between their bases, thick, curly and barbed (Figure 1B). Setae *j1* and *z1* short, spine-like, ca. 27 and 19 respectively; setae *jx* and at least two setae *Jx* shorter (37–38) and thinner than other dorsal setae (47–63) (Figure 1B); marginal setae *R* slightly thicker.

**Idiosomal venter** (Figures 2A, B) — Presternal shields present. Sternal shield arch-shaped and fused with endopodal elements between coxae I-II, II-III and III-IV; anterior margin concave and posterior margin strongly concave covered by genitoventral shield anterior margin; sternal shield 58 long medially, 115 wide at level of *st2*, with sternal setae *st1-st3* long (74), smooth and relatively thin, and three pairs of lyrifissures (*iv1*, *iv2*, *iv3*); setae *st1* on anterior margin



**Figure 1** *Reticulolaelaps caditanus* n. sp., female: A — Idiosoma, dorsal; B — Detail of notated dorsal setae; C — Gnathotectum; D — Chelicera, lateral view; E — Chelicera ventral view (movable digit removed).

of sternal shield and *st3* on endopodal region; transverse intervals *st1-st1* 65, *st2-st2* 100 and *st3-st3* 134; setae *st4* absent (Figure 2A, B); large genitoventral shield well ornamented with large cells except on posteromedial region; shield contiguous with exopodal shield posterior to coxae IV; genitoventral anterior margin overlaps more than half the length of the sternal shield (arriving to half the distance between *st1* and *st2*), posterior border contiguous with anal shield; shield 354 long, 334 wide at level of first pair of ventral setae *ZV1*; genital setae (*st5*) set at level of coxae IV, similar to sternal setae (83–84 long); genitoventral shield with five pairs of ventral setae (*JV1-JV3*, *ZV1-ZV2*), three anterior pairs 83 long and two posterior pairs on posterior border of shield 56 long; shield with one pair of lyrifissures *ivo* discernible. Anal shield twice as wide as long (112 long 215 wide), with anterior margin straight, posterior margin rounded; well reticulated, and with subequally short, thin circum-anal setae 25 long; gland pores *gv3* on



**Figure 2** *Reticulolaelaps caditanus* n. sp., female: A — Idiosoma, ventral (ventral setae in solid black); B — Detail of sternal shield (gcx: coxal gland pores); C — Sternapophysis; D — Right palp, lateral view; E — Subcapitulum with palp-trochanter; F — Detail of paralabrum, salivary styli, corniculi and inner lobes of interna malae; G — detail of corniculi, dorsal view; H — Detail of inner lobe of internal malae.



border of the shield at level of anal opening. Opisthogastric soft cuticle with four pairs of setae (*JV4*, *JV5*, *ZV3*, *ZV4*), with *JV5* being the thickest, and four pairs of lyrifissures, including *ivp*.

Exopodal plates smooth on surface, evenly pointed posteriorly behind coxae IV, continuously fused in a strip alongside coxae II to IV. Peritrematal shields free from exopodals and fused to dorsal shield at level of setae *s3*; posterior peritrematal shield end contiguous with genitoventral shield at level of setae *ZV1* (Figure 2A); this shield with two pairs of discernible glandular openings (*gp2*, *gp3*) and two pairs of lyrifissures (*ip2*, *ip3*). Peritremes well developed, extending to level of setae *z1*. Spermathecal structures unsclerotized, indiscernible.

**Gnathosoma** — Tritosternum normal in shape, 78 long, with short base 17 long and two slender, sparsely pilose lacinia, 61 long and fused half their length (Figure 2C). Anterior margin of gnatotectum rounded, smooth, with membranous cuticle; posterior surface with characteristic pattern (Figure 1C). Labrum long and wide, extending beyond the palpal flaps, densely pilose. Chelicerae small, entire shaft 102 long, fixed chela with two small teeth and pilus dentilis relatively thick (Figure 2E); movable chela bidentate (31–35 long) (Figure 2D). Deutosternum narrow with four transverse rows of few denticles (3–5 denticles), first dentate row behind the insertion of hypostomal setae *hp3* (Figure 2E). Corniculi horn-like (33 long), with latero-dorsal hook (Figure 2F, G); internal malae complex, with two acute hook-like outer lobes with smooth edges and a pair of conspicuous, elongate and rough inner lobes; paralabrum with pilose internal margin (Figure 2F). Hypostomal setae thin, *hp3* longest (56), *hp1* ca. 42, *hp2* ca. 18, and capitular seta ca. 24. Salivary styli with truncated tip. Palpus 117–124 long, palp-tibia and tarsus 36 long; large membranous paraxial flaps on palp-trochanter cover the corniculi (Figure 2D, E); ventral setae of palp-trochanter on the flap, distal seta hyaline, rod-like in shape and longer (14–17) than basal setae (12–14); ventral setae on palp-femur and palp-genu spine-like and longer than other setae on the segment (17–23).

**Legs** (Figures 3A–J) — Length of legs I–IV, excluding ambulacrum, respectively as follows: 430, 330, 298 and 421. Leg segments conspicuously reticulated. Complement of coxal setae legs I–II–III–IV, respectively, 2–2–2–1; that of trochanters 6–5–5–5; that of femora 13 (2 3/2 2/2 2) – 9 (1 2/2 2/1 1) – 6 (1 2/1 1/0 1) – 6 (1 2/0 1/1 1); that of genua 13 (2 3/1 3/2 2) – 11 (2 2/1 3/1 2) – 8 (2 2/1 2/0 1) – 10 (2 2/1 3/1 1) and that of tibiae 13 (2 3/2 3/1 2) – 10 (2 2/1 2/1 2) – 8 (1 2/1 2/1 1) – 10 (1 2/1 3/1 2). Tarsus I with reduced chaetome (5 22/8 5), as long as tarsus IV (length 123–125), with small claws (8–10) and pulvilli (Figures 3F–J); seta “s” long, with rod-like tip (Figure 3H); other distal sensorial setae as in figure 3I. Tarsi II–IV (3 3/2 1/1 3/2 3), ventral setae “v-3” (39) two times longer than “d-1”; ventral distal process rounded and poorly sclerotized; apical setal processes “d-1” shorter than pretarsus (9–12); small claws (7–9), lobulated pulvilli and short paradactyls (Figure 3E). Strong thick spine-like setae on legs I and II: trochanter I (*pd-1*), femur I (*al-1*, *al-2*, *av-1*, *av-2*, *pv1*, *pl-2*), genu I (three ventral setae), tibia I (three ventral setae); femur II (*av-1*), genu and tibia II (*av-1*, *pv-1*); thicker setae on genu III (*av-1*); tibia III (*av-1*, *pv-1*); genu and tibia IV (*av-1*, *pv-1*). Femur I with a lyriform area at the postero-ventral basal region (Figure 3A). Distal border of leg segments strongly dentate.

Male of the species and immature instars are unknown.

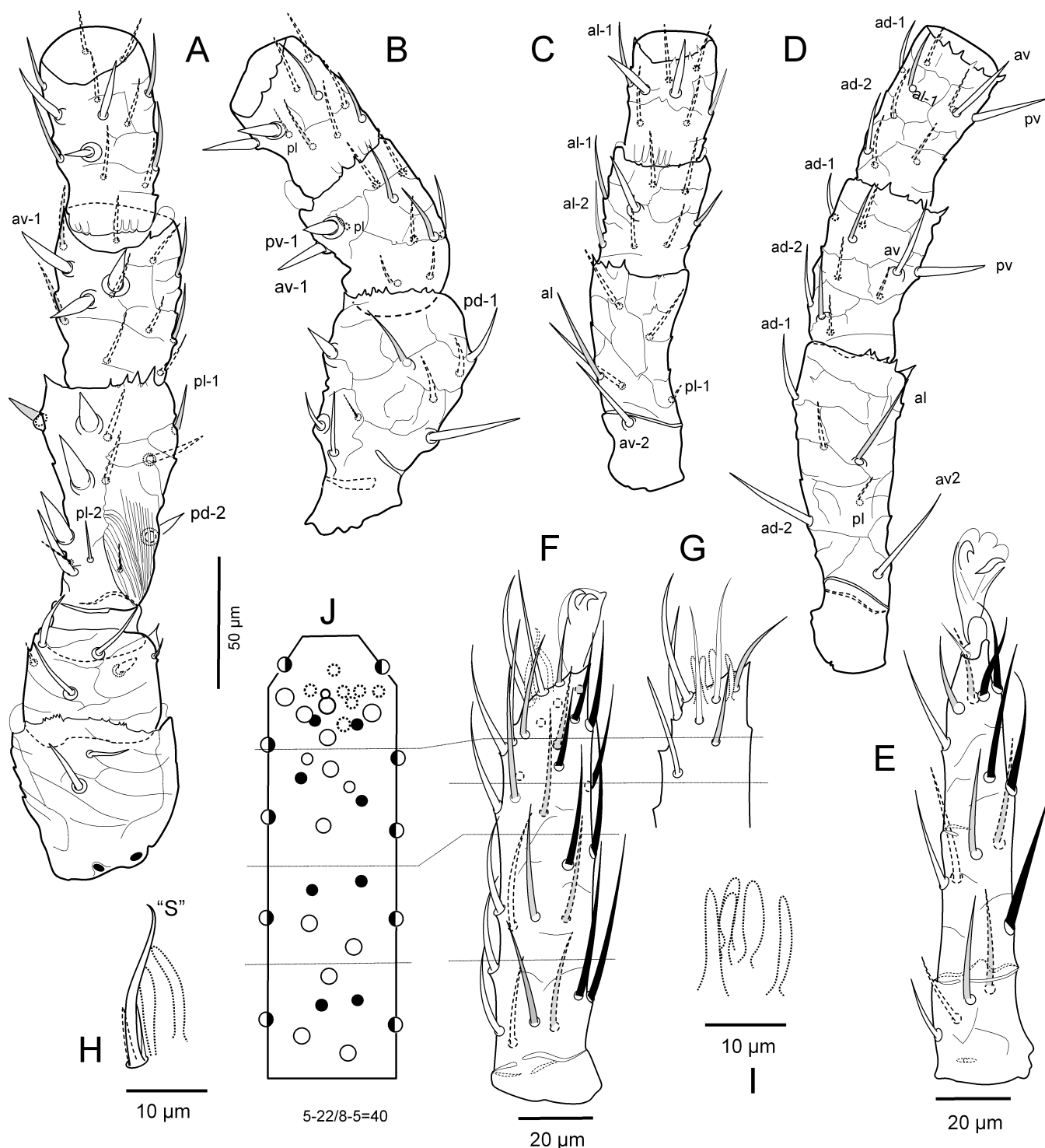
**Etymology** — The species name “caditanus” refers to the Spanish province where the new species was found.

**Type material** — Holotype, female, from oothecal cell of *Mantis religiosa*, San Roque (Cádiz), La Alcaidesa, 30STF31, 24-II-2008, I. Sánchez leg.; one paratype female from the same locality and date.

**Remarks** — Differences between this species and other known members of *Reticulolaelaps* are summarized in the key to the species. The pattern of idiosomal glands and lyrifissures (incompletely illustrated in this work) is similar to the pattern described by Kazemi & Beaulieu (2016) for other members of Laelapidae.

## Revised diagnosis of genus *Reticulolaelaps*

The last review of the genus *Reticulolaelaps* given by Nemati et al, (2019) can be extended after the description of *R. caditanus* n. sp..



**Figure 3** *Reticulolaelaps caditanus* n. sp., female, right legs I-IV (excluding coxa II-IV and tarsus II-III): A — Leg I, ventral view; B — Leg II, posteroventral view; C — Leg III, ventral view; D — Leg IV, anteroventral view. Lateral setae on the segments shown in solid grey; E — Tarsus IV, lateroventral view; F — Tarsus I, anterolateral view; G — Distal region of tarsus I, posterolateral view; H — Group of dorso distal sensorial setae, including seta “s”; I — Detail of posterolateral distal group of olfactory setae; J — Diagrammatic representation of tarsus I chaetome (solid black symbols refer to ventral setae). Lateral setae on the segments shown in solid grey; ventral setae on tarsus I and IV shown in solid black.

The well-sclerotised, reticulate, convex holodorsal shield hypertrichious: podonotal region with complete chaetome, may bear extra setae *ix*; setae *j1*, *z1*, together with *id1*, on the vertical region of shield are different in shape and length from the rest of dorsal setae; setae *r6* off shield, on soft lateral cuticle. Dorsal poroidotaxy and adenotaxy as other members of the family (Figure 1A).

**Adult females.** Presternal plates present or absent; sternal shield with concave posterior margin, extended to at least the midlevel of coxa III, always fused with endopodal I-II and II-III, endopodal III-IV joined with posterolateral extensions of sternal shield anteriorly; sternal setae *st1-st3* and poroids *iv1-iv3* on shield and metasternal setae *st4* absent; gland pores *gvb* present; genitoventral shield large, expanded posterior to coxae IV abutting large, wide anal shield, capturing metapodal plates or with free metapodal plates; shield with three (*st5*, *JV1*, *ZV1*) to six pairs of setae (*st5*, *JV1-JV3*, *ZV1*, *ZV2*); setae *JV4*, *JV5*, *ZV3*, *ZV4*, and *ZV5* when present, always on soft opisthogastric cuticle. Exopodal, parapodal and endopodal plates usually fused, sometimes only fused with endopodal III-IV; exopodal and parapodal plate contiguous with peritrematal and usually with genitoventral shields, respectively. Peritrematal shields extending posteriorly to coxa IV with *gp2*, *gp3*, *ip2*, *ip3*; peritreme long, extending behind coxa III or IV. Gnathotectum with anterior margin smooth, anterior surface membranous and posterior sclerotized portion punctate and especially ornate with a medial lobed cell and two lateral reticula (Figure 1C, figure 75 in Costa (1968) and figure 2A in Joharchi & Babaeian (2015). Tritosternum with small base and laciniae fused together for half their length. Small cheliceral shafts; fixed digit bidentate and movable digit with a few relatively large teeth (two–three teeth); pilus dentilis and dorsal setae moderately thick and arthrodial membrane filamentous. Corniculi poorly sclerotized, relatively elongated with a dorsolateral hook keel (Figure 2G); internal malae with two acute, narrow inner lobes with smooth antiaxial margins and rough inner margins and a pair of conspicuous outer, horn-like lobes; salivary styli thin, slightly sinuous, reaching anterior margin of palp-trochanter. Hypostomal groove narrow, with four rows bearing few denticles (2–6); hypostomal setae *hp1*, *hp3* at least twice as long as *c*; palp chaetotaxy normal for the family; palp tarsus with two distinct tines; trochanter with a large membranous flap originating as an extension of the paraxial margin (Figure 2D,E); ventral setae on palp-femora and palp-genua spine-like in shape and longer than other setae on these segments. Legs chaetotaxy, that of femur 13 (2 2/2 3/2 2) – 9 (1 2/2 2/1 1) – 6 (1 2/1 1/0 1) – 6 (1 2/0 1/1 1); that of genu 13 (2 3/1 3/2 2) – 11 (2 2/1 3/1 2) – 8 (2 2/1 2/0 1) – 10 (2 2/1 3/1 1) and that of tibia 13 (2 3/2 3/1 2) – 10 (2 2/1 2/1 2) – 8 (1 2/1 2/1 1) – 10 (1 2/1 3/1 2); genu IV *pl-2* absent, tibia III, *pl-2* absent; tarsus I with complete chaetome reduced to 40 setae (5 22/8 5); tarsus II-IV apical ventral process rounded, with claws and lobulated pulvilli.

**Adult male.** Dorsal shield, gnathosoma, and legs similar to that of the female. Cheliceral digits unidentate, spermatodactyl short and straight. Male with sternal-genitoventral or holovenral shield with 10 pairs of setae (*st1-st5*, *JV1-JV3*, *ZV1*, *ZV2*) and abutting anal shield as in the females.

*Reticulolaelaps* shares several characters with other genera of the family such as *Cyclothorax* von Frauenfeld, 1868, *Gecarcinolaelaps* Casanueva, 1993, *Iphiolaelaps* Womersley, 1956, *Iphiopsis* Berlese, 1882, *Jacobsonia* Berlese, 1910, *Myrmozercon* Berlese, 1903, *Narceolaelaps* Kethley, 1978, *Urozercon* Berlese, 1902, and members of the Iphiopsidae Kramer. All these genera are associated with different arthropods. *Reticulolaelaps* has been found in ant nests, but has never been found on ants themselves. *R. caditanus* n. sp. has been found in the oothecal cell of a mantid insect sharing habitat with the predatory genus *Bdella* Latreille, 1795 and oribatids such as *Bipassalozetes bidactylus* (Coggi, 1900) and *Phauloppia pilosa* (C.L. Cock, 1841) (Moraza & Sanchez, 2016). However, the association of *R. caditanus* with the mantid insect has been ruled out since the cell was long empty; the cell may have only served as a safe space to feed and take refuge.

Due to its cheliceral morphology, Joharchi and Babaeian (2015) speculated that *Reticulolaelaps* prey on small invertebrates in the ant nests. Its gnathosomal structures (internal malae complex, large membranous flaps on the palp-trochanter and gnathotectum with anterior



membranous part) could be structural adaptations to help it to obtain food. The flaps overlap the distal ventral region of the gnathosoma and those, together with anterior membranous part of the gnathotectum, which dorsally covers the buccal region, form an enclosed space that may improve control over the prey after tearing into it with its small, yet powerful, chelicerae.

## Key to the world species of *Reticulolaelaps* (females)

Modified from Nemati *et al.*, 2019 and *R. jilinensis* excluded.

1. Genitoventral shield with 3–4 pairs of setae (including *st5*) ..... 2  
 — Genitoventral shield with 6 pairs of setae (including *st5*) ..... 3
2. Genitoventral shield with 3 pairs of setae; parapodal plates crescent shape and separated from genitoventral shield; setae *Z5* as long as other opisthonotal setae; anal shield rounded ...  
 ..... *R. elsa* (Joharchi *et al.*, 2016)  
 — Genitoventral shield with 4 pairs of setae; parapodal plates triangular and fused with genitoventral shield; setae *Z5* shortest opisthonotal setae; anal shield triangular in shape .....  
 ..... *R. lativentris* Karg (1978)
3. Endopodal plates III-IV narrowly joined with sternal shield ..... 4  
 — Endopodal plates III-IV widely joined with sternal shield ..... 5
4. Dorsal setae thick and falciform; sternal setae longer than ventral setae on soft cuticle; anal shield with smooth lateral sides; idiosoma 620 long, 390 wide .....  
 ..... *R. costai* Joharchi & Babaeian, 2015  
 — Dorsal setae acicular; sternal setae as long as ventral setae; anal shield with notch in lateral sides; idiosoma 557 long, 348 wide .....  
 ..... *R. hallidayi* Joharchi, Nemati & Babaeian, 2013
5. Dorsal shield with setae curly and heavily barbed, longer than intervals between their bases; presternal shields present; sternal setae as long as ventral setae; membranous region of gnathotectum poorly developed; idiosoma 537 long, 439 wide .....  
 ..... *R. caditanus* n. sp.  
 — Dorsal shield with setae simple and thin, shorter than intervals between their bases; presternal shields absent; membranous region of gnathotectum conspicuously ornate, as long as sclerotized basal region; sternal setae longer than ventral setae; idiosoma 560 long, 380 wide .....  
 ..... *R. faini* Costa, 1968

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